# APPENDIX I

# GLOSSARY

**ADDEND** —A number to be added to an augend.

**ADDITION** —A form of counting where on quantity is added to another.

**AND GATE** —A logic circuit in which all inputs must be HIGH to produce a HIGH output.

**ASSOCIATIVE LAW** —A simple equality statement A(BC) = ABC or A+(B+C) = A+B+C.

**AUGEND** —A number to which another number is to be added.

**BASE** —The number of symbols used in the particular number system.

**BCD (BINARY CODED DECIMAL)** —A method of using binary digits to represent the decimal digits 0 through 9.

**BINARY SYSTEM** —The base 2 number system using 0 and 1 as the symbols.

**BOOLEAN ALGEBRA** —A mathematical concept based on the assumption that most quantities have two possible conditions —TRUE and FALSE.

**BOOLEAN EXPRESSION** —A description of the input or output conditions of a logic gate.

**BORROW** —To transfer a digit (equal to the base of the number system) from the next higher order column for the purpose of subtraction.

**CARRY** —A carry is produced when the sum of two or more numbers in a vertical column equals or exceeds the base of the number system in use.

**CLOCK** —A circuit that generates timing control signals in a computer or other type of digital equipment.

**COMMUTATIVE LAW** —The order in which terms are written does not affect their value; AB = BA, A+B = B+A.

**COMPATIBILITY** —The feature of logic families that allows interconnection of circuits without the need for additional circuitry.

**COMPLEMENT** —Something used to complete something else.

**COMPLEMENTARY LAW** —A term ANDed with its complement is 0, and a term ORed with its complement is 1; $A\overline{A} = 0$, $A + \overline{A} = 1$.

**CONVERSION** —To change a number in one base to its equivalent in another base.

**COUNTER** —A device that counts.

**D FLIP-FLOP** —Stores the data bit (D) in conjunction with the clock input.

**DECADE COUNTER** —Counter from 0 to $10_{10}$ in base 2, then resets.

**DECIMAL POINT** —The radix point for the decimal system.

**DECIMAL SYSTEM** —A number system with a base or radix of 10.

**DEMORGAN'S THEOREM** —This theorem has two parts: the first states that $\overline{AB} = \overline{A} + \overline{B}$; the second states that $\overline{A + B} = \overline{A}\ \overline{B}$.

**DIFFERENCE** —That which is left after subtraction.

**DISTRIBUTIVE LAW** —(1) a term (A) ANDed with a parenthetical expression (B+C) equals that term ANDed with each term within the parenthesis: A(B+C) = AB+AC; (2) a term (A) ORed with a parenthetical expression (BC) equals that term ORed with each term within the parenthesis: A+(BC) = (A+B)(A+C).

**DIVIDEND** —A number to be divided.

**DIVISOR** —A number by which a dividend is divided.

**DOUBLE NEGATIVE LAW** —A term that is inverted twice is equal to the term; $\overline{\overline{A}} = A$.

**DOWN COUNTER**—A circuit that counts from a predetermined number down to 0.

**EXCLUSIVE-NOR (X-NOR)** —A logic circuit that produces a HIGH output when all inputs are LOW or all inputs are HIGH.

**EXCLUSIVE-OR (X-OR) GATE** —A logic circuit that produces a HIGH output when one and only one input is HIGH.

**EXPONENT** —A number above and to the right of a base indicating the number of time the base is multiplied by itself; $2^4 = 2 \times 2 \times 2 \times 2$.

**FLIP-FLOP** —A bistable multivibrator.

**FRACTIONAL NUMBER** —A symbol to the right of the radix point that represents a portion of a complete object.

**HEXADECIMAL (HEX) SYSTEM** —The base 16 number system using 0 through 9 and A, B, C, D, E, and F as symbols.

**IDEMPOTENT LAW** —States that a term ANDed with itself or ORed with itself is equal to the term; AA = A, A+A = A.

**INVERTER** —A logic gate that outputs the complement of its input.

**J-K FLIP-FLOP** —Can perform the functions of the RS, T, and D flip-flops.

**LAW OF ABSORPTION** —This law is the result of the application of several other laws. It states that A(A+B) = A or A+(AB) = A.

**LAW OF COMMON IDENTITIES** —The two statements A($\overline{A}$ +B) = AB and A+ $\overline{A}$ B = A+B are based on the complementary law.

**LAW OF IDENTITY** —States that a term TRUE in one part of an expression will be TRUE in all parts of the expression; A = A, $\overline{A} = \overline{A}$.

**LAW OF INTERSECTION** —A term ANDed with 1 equals that term, and a term ANDed with 0 equals 0; $A \cdot 1 = A$, $A \cdot 0 = 0$.

**LAW OF UNION** —A term ORed with 1 equals 1; a term ORed with 0 equals that term; A+1 = 1, A + 0 = 0.

**LEAST SIGNIFICANT (LSD)** —The digit which has the least effect on the value of a number.

**LOGIC** —The science of reasoning; the development of a reasonable or logical conclusion based on known information.

**LOGIC FAMILY** —A group of logic circuits based on specific types of circuit elements (DTL, TTL, CMOS, and so forth).

**LOGIC GATES** —Decision-making circuits in computers and other types of equipment.

**LOGIC POLARITY** —The polarity of a voltage used to represent the logic 1 state.

**LOGIC SYMBOL** —Standard symbol used to indicate a particular logic function.

**MINUEND** —The number from which another number is subtracted.

**MIXED NUMBER** —Represents one or more complete units and a portion of a single unit.

**MODULUS** —The number of different values that a counter can contain or display.

**MOST SIGNIFICANT DIGIT (MSD)** —The digit which if changed will have the greatest effect on the value of a number.

**NAND GATE** —An AND gate with an inverted output. The output is LOW when all inputs are HIGH, and HIGH when any or all inputs are LOW.

**NEGATIVE LOGIC** —The voltage representing logic state 1 is more negative that the voltage representing a logic state 0.

**NEGATOR** —See inverter.

**NOR GATE** —An OR gate with an inverted output. The output is LOW when any or all inputs are HIGH, and HIGH when all inputs are LOW.

**NOT CIRCUIT** —See inverter.

**NUMBER** —A symbol used to represent a unit or a quantity.

**OCTAL SYSTEM** —The base 8 number system using 0 through 7 as the symbols.

**OR GATE** —A logic circuit which produces a HIGH output when one or more inputs is/are HIGH.

**PARALLEL DATA** —Each bit of data has a separate line and all bits are moved simultaneously.

**PARALLEL REGISTER** —A register that receives, stores, and transfers data in a parallel mode.

**POSITIONAL NOTATION** —A method where the value of the number is defined by the symbol and the symbol's position.

**POSITIVE LOGIC** —The voltage representing logic state 1 is more positive than the voltage representing a logic state 0.

**POWER OF A NUMBER** —The number of times a base is multiplied by itself. The power of a base is indicated by the exponent; that is, $10^3 = 10 \times 10 \times 10$.

**QUOTIENT** —The result in division.

**RADIX POINT** —The symbol that separates whole numbers and fractional numbers.

**RADIX** —The total number of symbols used in a particular number system.

**REGISTER** —A circuit of flip-flops designed to receive, store, and transfer data.

**REMAINDER** —The final undivided part that is less than the divisor.

**RING COUNTER** —A loop in which only one flip-flop will be set at any given time; used in timing.

**RIPPLE (ASYNCHRONOUS) COUNTER** —A circuit that counts from 0 to a specified value. Subject to error at high frequency.

**R's (RADIX) COMPLEMENT** —The difference between a given number and the next higher power of the number system ($1000_8$ minus $254_8$ equals $524_8$).

**R's-1 (RADIX-1) COMPLEMENT** —The difference between a given number and the highest value symbol in the number system ($777_8$ minus $254_8$ equals $524_8$).

**R-S FLIP-FLOP** —A flip-flop with two inputs —S (set) and R (reset). The Q output is HIGH in the set mode and LOW in the reset mode.

**SERIAL DATA** —All data bits are transferred one bit at a time along a single conductor.

**SHIFT REGISTER** —A register capable of serial-to-parallel and parallel-to-serial conversion and scaling.

**SHIFTING** —Moving the contents of a register right or left to scale the number or to input or output serial data.

**SUBSCRIPT** —A number written below and to the right of a value indicating the base or radix of the number system in use ($35_8$).

**SUBTRACTION** —Taking away one number from another.

**SUBTRAHEND** —The quantity to be subtracted from the minuend.

**SUM** —The result in addition.

**SYNCHRONOUS COUNTER** —Performs the same function as a ripple counter but error free at high frequency.

**T FLIP-FLOP** —A single input flip-flop that changes state with each positive pulse or each negative pulse. Divides input frequency by two.

**TRUTH TABLE** —A chart showing all possible input combinations and the resultant outputs.

**UNIT** —A single object.

**UP/DOWN COUNTER** —A counter circuit that can count up or down on command.

**VINCULUM** —A bar over a logic statement indicating the FALSE condition of the statement.

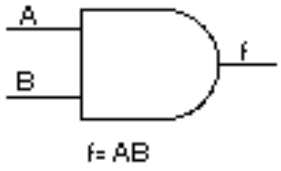
**WHOLE NUMBER** —A symbol that represents one or more complete objects.

**ZERO** —A symbol that indicates no numerical value for a position in positional notation.

## APPENDIX II

# LOGIC SYMBOLS

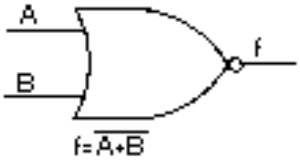
**AND**




f= AB

| A | B | f |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

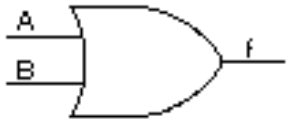
**NOR**




$f=\overline{A+B}$

| A | B | f |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

**OR**




f=A+B

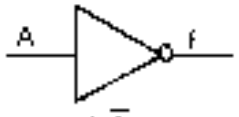
| A | B | f |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

**EXCLUSIVE-OR**


$f=A\oplus B=A\overline{B}+\overline{A}B$

| A | B | f |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

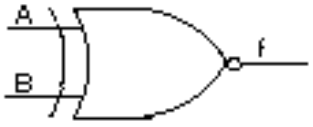
**INVERTER**




$f=\overline{A}$

| A | f |
|---|---|
| 0 | 1 |
| 1 | 0 |

**EXCLUSIVE-NOR**




$f=\overline{A\oplus B}$

| A | B | f |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

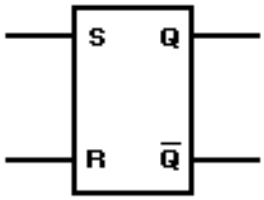
**NAND**


$f=\overline{AB}$

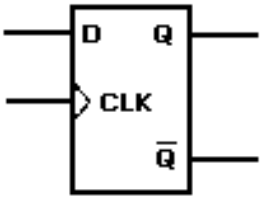
| A | B | f |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

# Logic Symbols (Cont'd)

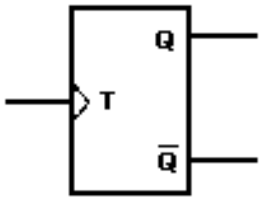
R-S FLIP-FLOP



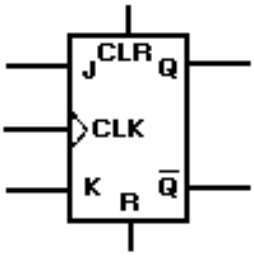

D FLIP-FLOP




T FLIP-FLOP




J-K FLIP-FLOP



# MODULE 13 INDEX

**T**



**U**



**V**



**Z**